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Original Article

The Children's Report of Sleep Patterns: validity and reliability of the Sleep Hygiene Index and Sleep Disturbance Scale in adolescents

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ABSTRACT

Objective: Sleep is critical for adolescent health and well-being. However, there are a limited number of validated self-report measures of sleep for adolescents and no well-validated measures of sleep that can be used across middle childhood and adolescence. The Children's Report of Sleep Patterns (CRSP) has been validated in children aged 8–12 years. The purpose of this study was to examine the psychometric properties of the CRSP, a multidimensional, self-report sleep measure for adolescents.
Methods: The participants included 570 adolescents 13–18 years, 60% female, recruited from pediatricians' offices, sleep clinics, children's hospitals, schools, and the general population. A multi-method, multi-reporter approach was used to validate the CRSP. Along with the CRSP, a subset of the sample completed the Adolescent Sleep Hygiene Scale (ASHS), with a different subset of adolescents undergoing polysomnography.
Results: The CRSP demonstrated good reliability and validity. Group differences on the CRSP were found for adolescents presenting to a sleep or medical clinic (vs. a community sample), for older adolescents (vs. younger adolescents), for those who regularly napped (vs. infrequently napped), and for those with poor sleep quality (vs. good sleep quality). Self-reported sleep quality in adolescents was also associated with higher apnea–hypopnea index scores from polysomnography. Finally, the CRSP Sleep Hygiene Indices were significantly correlated with indices of the ASHS.
Conclusions: The CRSP is a valid and reliable measure of adolescent sleep hygiene and sleep disturbances. With a parallel version for middle childhood, the CRSP likely provides clinicians and researchers the ability to measure self-reported sleep across development.
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1. Introduction

Sleep is a universal, basic drive that contributes to optimum physical and cognitive functioning, as well as overall well-being in adolescents. The consequences of insufficient sleep in adolescents include poorer academic performance [1,2], difficulty with emotion regulation [3], increased risk of injury or accidents [4], and weight gain [5]. A number of factors intersect to contribute to insufficient sleep in adolescents, including a biological phase delay, increased homework and extracurricular activities (including jobs), social demands, caffeine use, technology use, and, most notably, early school start times [6–9]. While sleep is known to change from childhood through adolescence [10], there are currently no published self-report measures of sleep that can be used in both school-aged children (8–12 years) and adolescents (13–18 years). The purpose of this study was to examine the psychometric properties of the Children's Report of Sleep Patterns (CRSP) in adolescents.

Along with the need to have a longitudinal self-report measure of sleep in pediatrics, it is important to have a well-validated self-report measure of adolescent sleep for several reasons. First, objective measures of sleep (i.e., polysomnography or PSG and actigraphy) do not capture the adolescent's perceived sleep, especially in terms of sleep quality or sleep hygiene. The subjective report of sleep quality is important to measure, with one meta-analysis demonstrating that sleep quality was more strongly associated with school performance than actual sleep duration [11]. Second, parents are often less accurate when reporting on an adolescent's subjective experience of

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health and well-being [12], with this likely including the subjective report of sleep quality. For example, in a study assessing sleep complaints in pediatric brain tumor survivors using subjective sleep measures, the concordance between parent and child report ranged from fair to good [13], while the concordance between parent and adolescent report was poor [14]. Third, parents become less involved with bedtime routines and bedtimes as children get older. For example, one study found only 5% of parents set a bedtime in adolescents [9], while a more recent study highlighted the decline of parent-set bedtimes from 33% at age 13 years down to 0% at age 18 years [15].

While several adolescent self-report measures exist, none have been validated to be used in both middle childhood and adolescence. The CRSP was developed to fill the void of self-report measures of sleep in middle childhood (8–12 years) [16]. Items were developed based on other validated measures of sleep for children and adolescents, as well as the input of pediatric sleep experts. Due to a lack of measures that have been validated in both age groups, we examined the psychometric properties of the CRSP in adolescents with the goal of a validated self-report measure of sleep that could be used across development for children and adolescents aged 8–18 years.

1.1. Hypotheses

The purpose of this paper was to present the preliminary psychometric properties of the CRSP in a large sample of adolescents. We hypothesized that the CRSP would demonstrate adequate reliability and validity in adolescents aged 13–18 years. In particular, we expected that adolescents from the clinical sample (sleep disorders, asthma, and cancer) would have poorer self-reported sleep habits (i.e., more caffeine use, more activities in the hour before bed, more electronics use in the hour before bed, and more likely to sleep somewhere other than their own bed) and more self-reported sleep problems (i.e., bedtime worries, restless legs syndrome symptoms, insomnia, and parasomnias) than the healthy comparison sample. We further hypothesized that due to increasing academic, social, and extracurricular demands, older adolescents would have poorer sleep habits than the younger adolescents.

2. Methods

2.1. Participants

The study participants included 570 adolescents (13–18 years) who were enrolled in research studies in the following settings: (1) pediatric sleep clinics at two separate children's hospitals, (2) outpatient clinics and inpatient units of a children's hospital for oncology patients, (3) two independent Australian schools, and (4) an Internet-based sample of adolescents, including those with asthma (categorized in clinic group) and those without asthma (categorized in community group). Approval from each institutional review board was obtained, in addition to informed consent/assent from all participants. Data were collected from 2008 through 2014, across all seasons.

Data on nonparticipants were unavailable for the Australian school and Internet-based participation subgroups. In the Children's Hospital of Philadelphia (CHOP) sleep clinic, five adolescents refused participation – three due to participant burden and two with no reason provided. In the Children's of Alabama sleep clinic, no adolescents refused participation. Finally, in the oncology clinics, 44 adolescents refused participation; of those, 22 were passive refusals (e.g., no parent available for consent, patient was incapacitated, etc.), and 22 were active refusals (e.g., parent/child declined). Participants in the final sample were 60% female, had a mean age of 14.8 ± 1.4 years, and were 89% Caucasian. Complete demographic information is provided in Table 1.

2.2. Measures

While all participants completed the CRSP, additional measures were administered per each site's study protocol (see Table 1).

2.2.1. Children's Report of Sleep Patterns

A total of 570 participants completed the CRSP, a 76-item questionnaire that includes three modules (Sleep Patterns, Sleep Hygiene Index, and Sleep Disturbance Scale) [16]. Sleep Patterns includes bedtimes, wake times, sleep-onset latency, and sleep schedule variability, with questions asked about last night, typical weekdays when the child is in school, and typical weekends/holidays when the child is not in school. Additional questions deal with night waking frequency, night waking duration, naps, and subjective sleep quality with the time frame of "most days." While sleep scheduling variables are likely to change from weeknights to weekend nights, sleep continuity/quality is less likely to change. The Sleep Hygiene Index contains questions about caffeine use, activities before bed, sleep location (where the child falls asleep and wakes up), and electronics used in the hour before bed. The Sleep Disturbance Scale consists of questions about bedtime fears/worries, symptoms of restless legs syndrome, parasomnias, and insomnia. Participants were asked to answer questions from the Sleep Hygiene Index and Sleep

Table 1
Demographic information and measure completion by site.

	Sleep Clinics[a]	St Jude	Australia Schools	Internet Asthma	Internet Non-Asthma	Total
Study Enrollment						
Approached	85	127	–	–	–	–
Declined	5	44	–	–	–	–
Participated	80	83	158	120	129	570
Mean Age (SD)	14.98 (1.55)	15.28 (1.68)	14.27 (1.04)	15.00 (1.43)	15.03 (1.46)	14.84 (1.44)
Gender						
% Male	48.8	55.4	10.8	48.3	52.7	40.0
% Female	51.2	44.6	89.2	51.7	47.3	60.0
Race/Ethnicity						
% Caucasian	37	80.2	–	80.8	84.4	88.7
% Other	63.3	19.8	–	19.2	15.6	11.4
Measures (*n*)						
Test–Retest CRSP	–	24	33	–	–	57
ASHS	–	28	–	–	–	28
PSG	78	–	–	–	–	78

Abbreviations: SD, standard deviation; ASHS, Adolescent Sleep Hygiene Scale; PSG, polysomnography.
[a] Children's Hospital of Philadelphia and Children's of Alabama Sleep Clinics.

Disturbance Scale questions based on a typical week. Most items on the CRSP were based on a Likert scale: *Never* (never happens), *Not Very Often* (less than once a week), *Sometimes* (once or twice a week), *Usually* (three to five times a week), and *Always* (every day). Additional indicator items are included for snoring, enuresis, and nightmares. Higher scores are associated with poorer sleep hygiene or greater sleep disturbances. Items were developed based on existing measures, clinical experience, and input from pediatric sleep experts [16].

2.2.2. Adolescent Sleep Hygiene Scale

The Adolescent Sleep Hygiene Scale (ASHS), a measure of sleep hygiene for adolescents aged 13–18 years [17], was completed by 28 participants (see Table 1). Adolescents were asked to respond to 24 items regarding their sleep routines, such as eating, drinking, watching television, etc. Items are categorized into six domains: physiological, cognitive, emotional, environmental, substances, and sleep stability. The adolescents rated items on a six-point scale (*Never* = 6, *Once in a While* = 5, *Sometimes* = 4, *Quite Often* = 3, *Frequently* = 2, and *Always* = 1). The mean scores for each domain and overall total sleep were calculated, with higher scores indicative of better sleep hygiene. The ASHS has demonstrated good internal consistency (alpha = 0.80) [17]. In the current study, the ASHS was used as an assessment of convergent/divergent validity.

2.2.3. Polysomnography

Seventy-eight clinically referred adolescents underwent overnight PSG using the Sandman 9.2 PSG system. The recorded parameters included electroencephalography (F3-M2, F4-M1, C3-M2, C4-M1, 01-M2, and 02-M1), left and right electrooculogram, submental electromyogram, bilateral tibial electromyogram, electrocardiogram, oronasal airflow with three-pronged thermistor, nasal pressure with pressure transducer, rib cage and abdominal wall motion via respiratory impedance plethysmography, and end-tidal capnometry. Arterial oxygen saturation with pulse waveform, digital video, and audio were also recorded. Studies were scored based on American Academy of Sleep Medicine (AASM) pediatric criteria [18]. For the current study, the apnea–hypopnea index (AHI) was used to provide an index of the severity of obstructive sleep apnea (OSA) (no OSA: AHI < 1.5; mild OSA: AHI = 1.5–5; and moderate/severe OSA: AHI > 5). PSG was used as an assessment of criterion validity.

2.3. Data analyses

2.3.1. Confirmatory factor analysis

Confirmatory factor analysis (CFA; MPlus) was used to test the basic factor structure of the Sleep Disturbance Scales with two modifications to the child version of the CRSP. First, the Restless Legs subscale was divided into two factors: Restless Legs Symptoms (symptoms directly experienced by the adolescent) and Restless Legs Report (symptoms observed by others) because adolescents are less likely than children to be observed by their parents during their sleep and therefore are less likely to be told by someone else that they move in their sleep, kick their legs during sleep, etc. Second, item 42 (difficulties falling asleep because of worries about the day) had originally been categorized within the Insomnia subscale. This item was moved to the Bedtime Fears/Worry Scale to better capture cognitive distortions related to stress/anxiety in this age group given adolescents are often overextended with school, extracurricular activities, and part-time work. Composite scores were calculated for each of the Sleep Hygiene Indices and Sleep Disturbance Scales for use in data analyses. Square-root transformations were calculated for the Bedtime Fears/Worry Scale and Sleep Location Index to adjust for moderate positive skew. Preliminary data analyses revealed that clinical participants (from oncology, asthma, and sleep clinics; $M = 15.07 \pm 1.54$) were significantly older than community participants (from schools and non-asthma Internet subgroups; $M = 14.61 \pm 1.30$, $t(568) = 3.86$, $p < 0.001$); multivariate analysis of covariance (MANCOVA) was used to control age differences when appropriate.

2.3.2. Reliability

The internal consistency of each of the Sleep Disturbance Scales was estimated using Cronbach's α ($n = 558$). Internal consistency reliabilities of ≥0.7 are considered good, while reliabilities of 0.6–0.7 are considered acceptable [19]. Given the presence of multiple, potentially unrelated items within the Sleep Hygiene Indices (e.g., an adolescent who drinks soda may not also drink tea, although together these items indicate the frequency of caffeine use), internal consistency was not examined for these indices. Test–retest reliability was evaluated in a subsample [20,21] ($N = 57$; 8 weeks between administrations; see Table 1) using Pearson's correlation coefficients for indices and scales. Paired *t*-tests were used to examine differences between the administrations of the Sleep Hygiene Indices and Sleep Disturbance Scales.

2.3.3. Validity

Construct validity was evaluated via group comparisons. The groups included clinical versus community, age (13–14, 15–16, and 17–18 years), self-reported sleep quality (great/good and okay/poor), and nap frequency (always/sometimes and never/only when sick). MANCOVA was used to control for age among the clinical versus community and nap frequency groups; MANOVA was used for the remaining group comparisons.

Convergent and divergent validity were investigated using subscale scores of the ASHS ($n = 28$). Pearson correlations examined the association between CRSP index/scale scores and Substance, Environmental, Sleep Stability, Emotion, Cognitive, and Physiology Indices of the ASHS. Pearson correlations >0.70 were determined to be very strongly associated, while values >0.40 were strong, > 0.30 were moderate, and <0.30 were considered weak (Evans 1996).

The criterion validity was examined via a subsample of the study population that underwent PSG ($n = 78$). MANOVA was used to investigate differences in sleep hygiene and sleep disturbances for adolescents without OSA (AHI < 1.5), mild OSA (AHI = 1.5–5), and moderate to severe OSA (AHI > 5). Pearson correlation was used to examine the association between adolescent-reported sleep disturbances and AHI.

3. Results

3.1. Confirmatory factor analysis

All items loaded significantly onto their respective factors; see Table 2 for factor loadings. Moderate to good fit was demonstrated by indices such as the root mean square error of approximation (RMSEA) (0.08), standardized root mean square residual (SRMR) (0.06), and comparative fit index (CFI) (0.91), suggesting the model is consistent with sample data.

3.2. Reliability

The results for scale/index internal consistency and test–retest reliability are presented in Table 3. With the exception of the Bedtime Fears/Worry Scale ($\alpha = 0.61$), all Sleep Disturbance Scales met or exceeded the minimum consistency for group comparisons ($\alpha \geq 0.70$). However, the three items within the Bedtime Fears/Worry Scale are not necessarily expected to be highly related (e.g., an adolescent with fears may not also be thinking about the next day or worry). Regarding test–retest reliability, medium to large correlations between test administrations were found on most subscales

Table 2
Standardized Solutions by Confirmatory Factor Analysis.

Item	Factor				
	Restless Legs Symptoms	Restless Legs Report	Insomnia Symptoms	Bedtime Fears/Worries	Parasomnia Symptoms
48. Legs bother during night	0.84				
47. Funny feelings in legs	0.72				
49. Have to move legs during night	0.67				
66. Told kick legs during sleep		0.84			
67. Told move a lot in sleep		0.62			
51. Wake up during night			0.87		
18. Night waking frequency			0.79		
19. Return to sleep after waking			0.64		
50. Trouble falling asleep			0.50		
41. Upset/worried at sleep onset				0.85	
42. Can't fall asleep because thinking of day				0.60	
40. Scared at sleep onset				0.46	
68. Talk in sleep					0.74
69. Walk or cry out in sleep					0.52

($r = 0.34–0.82$). Significant differences between the first and second administrations were found for the Parasomnias subscale, with more symptoms reported at time 2 than time 1.

3.3. Construct validity

Significant multivariate effects were found for both the Sleep Hygiene Indices and Sleep Disturbance Scales, including age ($F(18, 1058) = 1.88$, $p = 0.015$) and sleep quality ($F(9, 530) = 21.01$, $p < 0.001$). Controlling for age, significant multivariate effects were also found for clinical/community group comparison ($F(9, 529) = 5.52$, $p < 0.001$) and nap frequency group comparison ($F(9, 528) = 7.02$, $p < 0.001$).

Table 4 presents group differences for the Sleep Hygiene Indices. Specifically, the clinical group (adolescents presenting to a medical (sleep or oncology) clinic or with asthma) reported more use of electronics before sleep onset ($F(1, 537) = 12.52$, $p < 0.001$) and that they were more likely to engage in activities in the hour before bed ($F(1, 537) = 5.07$, $p = 0.025$), as well as sleep somewhere other than their own bed ($F(1, 537) = 20.09$, $p < 0.001$). Older adolescents (17–18 years) reported using more electronics before bed ($F(2, 537) = 4.18$, $p = 0.016$), sleeping somewhere other than their own bed ($F(2, 537) = 3.07$, $p = 0.047$), and engaging in more activities in the hour before bed ($F(2, 537) = 6.50$, $p = 0.002$) than both 13–14- and 15–16-year-olds. Adolescents with good self-reported sleep quality reported less caffeine use ($F(1, 538) = 4.22$, $p = 0.040$), less electronics use at bedtime, ($F(1, 538) = 8.18$, $p = 0.004$), and that they were more likely to sleep in their own bed ($F(1, 538) = 7.36$, $p = 0.007$). Finally, adolescents who infrequently nap reported less electronics use at bedtime ($F(1, 536) = 25.81$, $p < 0.001$) and were more likely to sleep in their own bed ($F(1, 536) = 44.22$, $p < 0.001$).

Table 5 presents the group differences for the Sleep Disturbance Scales. Adolescents in the clinical group reported fewer symptoms of restless legs (self-reported) ($F(1, 537) = 0.139$, $p < 0.001$) and fewer parasomnias ($F(1, 537) = 6.77$, $p = 0.012$) than those in the community group. Adolescents with great/good sleep quality reported fewer bedtime fears or worries ($F(1, 538) = 29.90$, $p < 0.001$), restless legs symptoms (observed by others; $F(1, 538) = 23.66$, $p < 0.001$), and symptoms of insomnia ($F(1, 538) = 188.12$, $p < 0.001$) than adolescents with okay/poor sleep. Finally, adolescents who infrequently nap reported fewer bedtime fears or worries ($F(1, 536) = 8.18$, $p = 0.004$) and fewer insomnia symptoms ($F(1, 536) = 9.37$, $p = 0.002$). Notably, adolescents who regularly nap also reported fewer symptoms of restless legs syndrome (self-report) ($F(1, 536) = 3.47$, $p = 0.063$) and fewer parasomnias ($F(1, 536) = 5.65$, $p = 0.018$).

3.4. Criterion validity

No differences on the Sleep Hygiene Indices (Table 4) or Sleep Disturbance Scales (Table 5) were found between adolescents with no, mild, or moderate/severe OSA. However, self-reported typical sleep quality was significantly correlated with OSA severity ($r = –0.467$, $p = 0.014$), with increased severity of OSA associated with poorer typical sleep quality. OSA severity was also significantly correlated with fewer symptoms of insomnia ($r = –0.23$, $p = 0.05$).

3.5. Convergent validity

Significant associations were found between the CRSP and the ASHS (Table 6); of note, negative associations are reported because *lower* scores denote *more* problems on the ASHS, whereas higher scores indicate more problems on the CRSP. A significant association between the CRSP Electronics Use at Sleep Onset Index and both the ASHS Environmental Scale ($r = –0.503$, $p = 0.020$) and the ASHS Total Scale ($r = –0.589$, $p = 0.002$) was found, with less electronics use associated with better sleep environment (e.g., lighting, temperature, loud music, etc.) and with better overall sleep hygiene. The CRSP Sleep Location Index was also significantly associated with the ASHS Environmental Scale ($r = –0.658$, $p = 0.001$), with adolescents who reported regularly sleeping in their own bed also reporting a better sleep environment. The CRSP Activity Before Bed Index was associated with the ASHS Emotion Scale ($r = –0.444$, $p = 0.044$), with fewer activities in the hour before sleep associated with better emotional sleep hygiene at bedtime (e.g., less anxiety and emotional distress). The CRSP Restless Legs Symptoms Scale was significantly associated with both the ASHS Environmental Scale ($r = –0.509$, $p = 0.016$) and the ASHS Emotion Scale ($r = –0.514$, $p = 0.014$), with fewer restless legs symptoms associated with a better sleep environment and fewer strong emotions at bedtime. Finally, the CRSP Insomnia Scale was significantly associated with the Emotion Scale of the ASHS ($r = –0.577$, $p = 0.005$), with fewer insomnia symptoms associated with better emotional sleep hygiene.

4. Discussion

This paper demonstrates the reliability and validity of the CRSP as a multidimensional self-report measure of sleep for adolescents aged 13–18 years. Because adolescence is a time of increasing independence in which parents have less direct awareness of their children's sleep, it is essential for both researchers and clinicians to obtain self-reported sleep data from adolescents. In addition, the

Table 3
Descriptive statistics (*M*, SD), internal consistency (α), correlations, and paired *t*-tests for CRSP Sleep Hygiene Indices and Sleep Disturbance Scales for the full sample and test–retest subgroup.

Item	Mean (SD)	α	*Test-Retest subgroup (n = 57)*				
			Time 1 Mean (SD)	Time 2 Mean (SD)	*r*	*t*	*p*[d]
Sleep Hygiene Index							
Caffeine Index	7.15 (2.44)	–	6.98 (2.81)	7.00 (2.63)	0.79***	–0.09	.93
Soda	2.90 (1.16)		2.73 (1.15)	2.73 (1.25)	0.73***		
Tea	2.39 (1.24)		2.17 (1.17)	2.10 (1.12)	0.64***		
Coffee	1.87 (1.12)		2.12 (1.35)	2.21 (1.26)	0.84***		
Activities Before Bed Index	17.69 (3.00)	–	17.00 (2.82)	17.24 (3.22)	0.70***	–0.75	.46
Have activities (dance, sports, etc.)	2.50 (1.27)		2.59 (1.44)	2.68 (1.29)	0.59***		
Email/Instant Message	3.25 (1.35)		2.88 (1.21)	3.00 (1.21)	0.66***		
Watch TV/Movies	3.78 (0.98)		3.77 (1.04)	3.47 (1.05)	0.47**		
Play Video/Computer Games	2.77 (1.23)		2.19 (2.11)	2.21 (1.12)	0.77***		
Take Bath/Shower[a]	2.35 (1.25)		2.52 (1.42)	2.89 (1.37)	0.33*		
Read[a]	3.02 (1.13)		2.88 (1.10)	2.84 (1.17)	0.36*		
Sleep Location	8.89 (4.04)	–	8.18 (3.78)	8.33 (3.49)	0.82***	–0.49	.63
Fall asleep in sibling's bed	1.32 (0.78)		1.26 (0.82)	1.19 (0.50)	0.81***		
Fall asleep in parent's bed	1.42 (0.92)		1.27 (0.73)	1.25 (0.72)	0.49***		
Fall asleep in another location in house (e.g., couch)	1.97 (1.07)		1.53 (0.88)	1.60 (0.96)	0.54***		
Wake in sibling's bed	1.23 (0.67)		1.09 (0.29)	1.14 (0.41)	0.68***		
Wake in parent's bed	1.33 (0.83)		1.30 (0.85)	1.20 (0.67)	0.63***		
Wake in another location in the house	1.66 (1.01)		1.30 (0.74)	1.37 (0.76)	0.81***		
Electronics Use Before Bed	6.25 (2.80)	–	4.93 (2.31)	5.04 (1.91)	0.68***	–0.47	.64
TV in room	2.02 (1.43)		1.47 (1.14)	1.58 (1.18)	0.87***		
Listening to music	2.58 (1.35)		1.98 (1.10)	1.98 (1.12)	0.71***		
Light in room	1.68 (1.16)		1.30 (0.99)	1.33 (0.84)	0.34*		
Indicator Items		–					
Wet the bed	1.15 (0.59)		1.14 (0.51)	1.09 (0.47)	0.72***		
Nightmares	2.13 (0.92)		2.09 (0.71)	2.05 (0.83)	0.66***		
Wake very thirsty	2.40 (1.22)		2.36 (0.87)	2.32 (0.96)	0.39**		
Wake with headache	1.91 (0.96)		1.73 (0.76)	1.68 (0.83)	0.49***		
Snore[b]	1.95 (0.75)		1.56 (0.59)	1.51 (0.67)	0.41**		
Sleep Disturbance Scales							
Bedtime Fears/Worries Scale	5.98 (2.26)	0.61	5.57 (1.80)	5.27 (1.45)	0.68***	1.46	.15
Scared at sleep onset	1.53 (0.90)		1.42 (0.73)	1.42 (0.66)	0.71***		
Upset/worried at sleep onset	1.98 (0.98)		1.86 (0.97)	1.93 (0.88)	0.69***		
Can't fall asleep because thinking of day	2.56 (1.13)		2.95 (1.21)	2.83 (1.00)	0.66***		
Restless Legs Symptoms (Self Report) Scale	4.59 (2.69)	0.76	5.32 (2.25)	5.45 (2.11)	0.41**	–0.38	.71
Legs bother during night	1.63 (0.96)		1.51 (0.77)	1.77 (0.84)	0.37*		
Funny feelings in legs	1.71 (1.0)		1.66 (0.99)	1.64 (0.72)	0.38*		
Have to move legs during night	2.30 (1.23)		2.18 (1.14)	2.07 (1.02)	0.31*		
Restless Legs Symptoms (Observed) Scale	4.17 (1.33)	0.73	3.44 (1.18)	3.47 (1.44)	0.51***	–0.12	0.91
Told kick legs during sleep[b]	2.04 (0.78)		1.63 (0.69)	1.70 (0.80)	0.52***		
Told move a lot in sleep[b]	2.13 (0.71)		1.81 (0.73)	1.77 (0.75)	0.48***		
Insomnia Scale	9.61 (3.38)	0.73	9.64 (2.34)	8.98 (2.35)	0.34*	1.62	0.11
Trouble falling asleep	2.57 (1.15)		2.64 (0.84)	2.55 (1.00)	0.24		
Wake up during night[c]	2.49 (1.14)		2.28 (0.96)	1.86 (1.00)	0.33*		
Return to sleep after waking	2.42 (1.22)		2.09 (1.01)	1.77 (1.08)	0.43**		
Night waking frequency	2.11 (1.06)		1.98 (0.85)	1.86 (1.00)	0.24		
Parasomnias Scale	3.84 (1.50)	0.76	2.77 (0.95)	3.40 (1.38)	0.45**	–3.24	0.00**
Talk in sleep[b]	1.98 (0.75)		1.63 (0.76)	1.81 (0.73)	0.60***		
Walk in sleep[b]	1.86 (0.91)		1.14 (0.41)	1.58 (0.85)	0.37*		

Full sample $N = 570$, Test–Retest $N = 56$. Higher scores are associated with poorer sleep hygiene and more sleep disturbances. Unless otherwise noted, response choices were as follows: Never = 1, Not Very Often = 2, Sometimes = 3, Usually = 4, and Always = 5.

* $p \le 0.05$, ** $p \le 0.01$, *** $p \le 0.001$.

[a] Never = 5, Not Very Often = 4, Sometimes = 3, Usually = 2, and Always = 1.

[b] Never = 1, Sometimes = 2, and All the Time = 3.

[c] Almost every night (5–7 times/week) = 4, Several times a week (1–4 times/week) = 3, Every now and then (2–3 times/week) = 2, I almost never wake up during the night = 1.

[d] Indicates significance of *t*-test.

validation of the CRSP in adolescents provides a valuable contribution for both researchers and clinicians in that it is one of the only validated self-report measures with versions for both children (8–12 years) and adolescents (13–18 years), allowing for the potential to measure multiple aspects of sleep in youth across stages of development.

The ideal development of a pediatric sleep questionnaire is a complex process. One of the strengths of this measure is that the development process was more rigorous than some previous measures. Our approach included defining the purpose of the measure; utilizing a detailed literature review and expert interviews in the development of the items; piloting the measure; and examining the factor structure, validity, and reliability of the CRSP [22]. However, additional research is clearly needed to further validate, standardize, and provide more comprehensive normative data in adolescents.

In our sample, a five-factor structure for the Sleep Disturbance Scales was supported including Bedtime Fears/Worries, Restless Legs Symptoms (Experienced/Reported), Restless Legs Symptoms (Observed by Others), Insomnia, and Parasomnias. In this adolescent sample, all of the Sleep Disturbance Scales, with the exception of

Table 4
Means and standard deviations for the CRSP Sleep Hygiene Indices MANCOVA/MANOVA analyses.

	Caffeine	Activity Before Bed	Sleep Location[c]	Electronics Use at Sleep Onset
Group[a]				
Clinical ($n = 268$)	7.24 (2.36)	18.04 (3.03)*	3.04 (0.64)***	6.69 (2.96)***
Community ($n = 272$)	7.09 (2.50)	17.39 (2.96)	2.80 (0.53)	5.76 (2.58)
Age[b]				
13–14 ($n = 241$)	6.96 (2.41)	17.66 (2.92)**	2.91 (0.60)*	6.02 (2.75)*
15–16 ($n = 202$)	7.33 (2.41)	17.33 (3.11)	2.88 (0.54)	6.10 (2.79)
17–18 ($n = 97$)	7.31 (2.54)	18.65 (2.85)	3.05 (0.68)	6.96 (2.89)
Sleep Quality				
Great/Good ($n = 345$)	7.00 (2.34)*	17.70 (3.08)	2.87 (.0.56)**	5.96 (2.77)**
Okay/Poor ($n = 195$)	7.45 (2.59)	17.74 (2.88)	3.01 (0.65)	6.68 (2.82)
Nap Frequency[a]				
Never/When Sick ($n = 357$)	7.06 (2.44)	17.60 (3.03)	2.80 (0.53)***	5.77 (2.68)***
Sometimes/Every Day ($n = 182$)	7.32 (2.40)	17.95 (2.96)	3.15 (0.65)	7.09 (2.86)
PSG				
No OSA ($n = 36$)	7.41 (2.10)	18.16 (3.44)	3.07 (0.60)	7.59 (3.48)
Mild OSA ($n = 18$)	7.17 (2.28)	17.28 (2.97)	3.17 (0.52)	7.06 (2.44)
Moderate/Severe OSA ($n = 11$)	7.92 (2.11)	18.17 (2.17)	3.12 (0.48)	6.50 (2.28)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
[a] MANCOVA analyses controlled for age.
[b] Post hoc analyses yielded group differences among 17–18-year-olds versus 13–14- and 15–16-year-olds.
[c] Square-root transformation used.

Table 5
Means and standard deviations for the CRSP Sleep Disturbance Scales MANCOVA/MANOVA analyses.

	Bedtime Fears/Worry[b]	Restless Legs Symptoms (Observed)	Restless Legs Symptoms (Reported)	Insomnia	Parasomnia
Group[a]					
Clinical ($n = 268$)	3.41 (1.74)	4.53 (2.67)	4.00 (1.23)**	9.39 (3.32)	3.72 (1.50)*
Community ($n = 272$)	3.50 (1.49)	4.50 (2.62)	4.35 (1.38)	9.77 (3.47)	4.02 (1.50)
Age					
13–14 ($n = 241$)	3.53 (1.67)	4.65 (2.78)	4.22 (1.32)	9.80 (3.42)	3.82 (1.47)
15–16 ($n = 202$)	3.33 (1.43)	4.46 (2.45)	4.12 (1.37)	9.55 (3.43)	3.88 (1.55)
17–18 ($n = 97$)	3.54 (1.84)	4.31 (2.69)	4.19 (1.22)	9.10 (3.24)	4.01 (1.52)
Sleep Quality					
Great/Good ($n = 345$)	3.18 (1.49)***	4.11 (2.38)***	4.21 (1.35)	8.28 (2.95)***	3.90 (1.55)
Okay/Poor ($n = 195$)	3.95 (1.72)	5.24 (2.92)	4.11 (1.27)	11.88 (2.88)	3.83 (1.43)
Nap Frequency[a]					
Never/When Sick ($n = 357$)	3.32 (1.50)**	4.38 (2.67)	4.26 (1.31)*	9.28 (3.35)**	3.98 (1.52)*
Sometimes/Every Day ($n = 182$)	3.73 (1.81)	4.79 (2.58)	4.01 (1.34)	10.16 (3.44)	3.68 (1.47)
PSG					
No OSA ($n = 37$)	3.54 (2.08)	6.62 (3.54)	4.11 (1.37)	10.76 (3.43)	2.86 (0.95)
Mild OSA ($n = 18$)	2.94 (1.30)	5.11 (2.27)	3.44 (1.04)	8.94 (2.41)	2.72 (0.67)
Moderate/Severe OSA ($n = 12$)	2.83 (0.94)	6.00 (2.80)	3.50 (1.09)	9.75 (3.41)	2.33 (0.49)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
[a] MANCOVA analyses controlled for age.
[b] Square-root transformation used.

the Bedtime Fears/Worries Scale, demonstrated acceptable internal consistency. The Bedtime Fears/Worries Scale may serve more as an index of bedtime issues, with lower correlations between the three items (e.g., a child who is fearful may not be worrying about the next day). Furthermore, the test–retest reliability for our adolescent sample showed stability over time for almost all of the Sleep Hygiene Indices, Sleep Disturbance Scales, and indicator items. The only scale that differed over time was the Parasomnias subscale with both talking in sleep and walking in sleep reported more frequently at the second time point. It is possible that after completing the measure, adolescents became more aware of these events and queried parents about the frequency of their parasomnias.

Group differences in reported sleep highlight the construct validity of the CRSP. As hypothesized, adolescents with asthma and those seen in a sleep clinic or an oncology hospital reported poorer sleep hygiene (including more activities before bed, an inconsistent sleep location, and more electronics use at sleep onset). In addition, in support of our hypothesis, older adolescents were significantly more likely to report having activities in the hour before bed, sleeping somewhere other than their bed, and more electronics use at sleep onset than younger adolescents, likely as a result of increased competing activities and technology in the bedroom as adolescents age.

Adolescents with poor overall self-reported sleep quality also reported more caffeine use, a less consistent sleep location, and more electronics use at sleep onset. In addition, those with poor sleep quality also reported more bedtime fears and worries, as well as symptoms of insomnia and observed restless legs symptoms. It is unclear whether poor sleep hygiene is an outcome (e.g., increased caffeine use because adolescent did not sleep well the previous night) or a precipitator of poor quality sleep (e.g., because of drinking caffeine at dinnertime, adolescent was unable to fall asleep). Longitudinal studies are needed to disentangle this relationship, which ultimately may be interdependent.

Finally, adolescents who napped frequently also reported a more inconsistent sleep location, more electronics use at sleep onset, more bedtime fears and worries, and more symptoms of insomnia than did infrequent nappers. This supports the validity of the measure, as we would expect that those with poor nighttime sleep would be

Table 6
Correlation matrix for CRSP indices/subscales and ASHS indices and CRSP indices/subscales.

	ASHS Subscales						
	Physiology	Cognitive	Emotion	Environmental	Substances	Sleep Stability	Total
CRSP Subscales							
Caffeine Use	–0.38	0.03	–0.10	–0.23	–0.25	–0.30	–0.36
Activities Before Bed	0.05	0.20	0.45*	–0.13	–0.11	0.22	0.08
Sleep Location[a]	–0.44*	–0.14	–0.03	–0.66**	–0.26	–0.10	–0.04
Electronics Use at Sleep Onset	–0.22	–0.08	–0.39	–0.50*	0.10	–0.09	–0.59**
Bedtime Fears/ Worries[a]	0.02	0.11	–0.26	0.02	0.20	0.04	–0.26
Restless Legs Symptoms (Observed)	–0.39	–0.13	–0.51*	–0.51*	0.09	0.09	–0.08
Restless Legs Symptoms (Reported)	0.20	0.36	0.00	–0.12	–0.05	0.09	–0.15
Parasomnias	0.28	0.21	0.19	0.02	0.01	0.12	–0.19
Insomnia	–0.02	–0.29	–0.58**	0.13	0.08	0.06	–0.20

Abbreviations: CRSP = Children's Report of Sleep Problems. ASHS = Adolescent Sleep Hygiene Scale.
* $p < 0.05$, ** $p < 0.01$.
[a] Square-root transformation used.

more likely to nap during the day, in turn disrupting nighttime sleep. Further, this finding highlights the importance of asking adolescents in clinical settings about their napping habits as a proxy for the impact of and contributor to poor sleep. Surprisingly, infrequent nappers were more likely to self-report restless legs symptoms and parasomnias than did regular nappers. For parasomnias, it is possible that without a daytime nap, the adolescents obtain deficient sleep, which increases the likelihood of parasomnia events. However, we were surprised by the finding of increased restless legs symptoms in those who do not regularly nap. As youth with restless legs syndrome tend to also report more daytime sleepiness (due to disrupted sleep), we would have expected more naps in this group. It may be possible that with increased symptoms of restless legs during inactivity, those with RLS symptoms are less likely to choose to lie down unless it is necessary, thereby avoiding naps. Future studies should further examine this issue with larger samples of youth with symptoms of restless legs syndrome.

The criterion validity was demonstrated with a significant negative correlation between OSA severity and self-reported typical sleep quality and insomnia symptoms. This indicates that with more severe sleep-disordered breathing, self-reported sleep quality was poorer, likely due to the feeling of not being refreshed after a night of sleep with sleep-disordered breathing. In addition, the relationship between sleep-disordered breathing and symptoms of insomnia likely reflects difficulties with sleep maintenance.

Convergent and divergent validity was demonstrated by comparing the subscales of the CRSP with the ASHS. As expected, significant relationships were found between the two measures, with poorer sleep hygiene, as well as insomnia symptoms, measured by the CRSP associated with poorer sleep hygiene on the ASHS. Notably, adolescents who reported more symptoms of restless legs on the CRSP also reported poorer sleep hygiene on the ASHS, particularly related to emotional distress and environmental conditions not conducive to sleep; this perhaps suggests that these adolescents may be attempting to distract themselves from their restless legs symptoms through activity (e.g., watching television, listening to music, etc.). Overall, the results demonstrate that the CRSP measures some similar aspects of sleep hygiene as the ASHS. However, the advantage of the CRSP is that it also includes modules of sleep patterns and sleep disturbances, including symptoms of restless legs syndrome, insomnia, parasomnias, and indicators of other sleep disorders.

One goal in the development of the CRSP was to have a measure that could be used with many different groups, allowing for broader comparisons across different populations in research. In addition, we wanted the CRSP to be a measure that could be used in clinic-, school-, or community-based settings. Thus, we included a heterogeneous sample in this study, which differs from previous sleep measure validation studies that have focused on a single population (e.g., children presenting to a sleep clinic [23] or children with autism [24]). While we see this as a study strength, we also recognize that this may result in poorer generalizability to specific populations. Thus, further research validating the CRSP in specific populations is necessary.

It is important to note other limitations of this study. While sleep patterns are an important part of the CRSP, we did not have actigraphy or daily sleep diary data that would allow us to validate this portion of the measure. However, adolescents have been shown to be relatively good reporters of their sleep patterns, as in Wolfson et al. [25], and the questions included in the CRSP still hold utility as a clinical or descriptive measure. Our sample size was not determined a priori, but rather we included samples from studies that had used the CRSP with adolescents. These individual studies were each powered for their specific study questions. However, to ensure sufficient power in the current study, we ran a post hoc power analysis using expected differences found in the child version of the CRSP [16] and found that a sample of 49–95 subjects per group would provide 80% power (alpha 0.05) to detect significant differences between our clinical and community groups. Although we had a large sample of adolescents from both clinical and community samples complete the CRSP, not all participants completed all measures or underwent PSG. In addition, nonparticipant rates were not available for two of the samples, and youth who declined participation may have had different sleep patterns or disturbances that would have impacted the outcomes. Furthermore, race/ethnicity data were not collected from the Australian schools, and no SES measurements for any of the samples were provided. This limits our ability to determine the generalizability of the findings across all racial, ethnic, and socioeconomic groups. For the Internet sample, it is possible that there was false reporting and/or a parent (rather than a teen) completed the measures. However, Internet surveys have been used successfully in a number of research studies, including measure validation [26–29]. Finally, our clinical samples were limited to adolescents seen in sleep disorders centers, as well as those with asthma or cancer. We also did not measure health issues in our community samples. However, the inclusion of different clinical populations remains a strength of the study and leads us to believe that the CRSP would be equally useful in other clinical samples (e.g., endocrinology), as well as primary care settings.

4.1. Conclusions

Despite these limitations, this study shows that the CRSP has demonstrated reliability and validity in a large sample of adolescents, including those with identified health conditions including obstructive sleep apnea, asthma, and cancer. There is a substantial

need for a self-report sleep measure in pediatrics that can be used across development, from middle childhood to adolescence in both healthy and at-risk populations. With consistent questions and acceptable psychometric data for both the child (8–12 years) and adolescent (13–18 years) versions, we believe that the CRSP is the first measure that addresses this need. However, longitudinal studies are needed to support this conclusion.

The validation of the CRSP in adolescents provides important information from multimodal (subjective and objective sleep findings) and multisite (clinical and community samples) data collection. Although the CRSP was not designed as a diagnostic tool and does not have established clinical cutoffs, we believe that a self-report measure that includes both children and adolescents will allow for longitudinal comparisons of sleep functioning before and after treatment in a clinical setting. Further, researchers may be able to assess developmental changes in sleep with increased validity and reliability.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2014.08.010.

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